

At Edwards Air Force Base, pilots in the Global Hawk Operations Center can monitor the drone's flight in real-time and can adjust and respond to any sudden change in conditions or scenarios. Photos by Clark Perry.



# Global Hawks to Take to the Skies—for NASA

By Clark Perry

**T**he scientific community will be looking up this spring when a well-known unmanned aircraft takes to the skies in a new mission to study the Earth's atmosphere.

Two Northrop Grumman-built Global Hawk UAS have been reconfigured from their original military capabilities to fulfill the needs of atmospheric scientists and one recently made its public debut for its new job.

NASA, in a five-year, \$25 million partnership with Northrop Grum-

man, secured use of the aircraft in 2007. In January, the first revamped Global Hawk was unveiled at NASA's Dryden Flight Research Center at Edwards Air Force Base in California. Its first scientific mission is slated for June.

"The Global Hawk aircraft represents a real paradigm shift for airborne science and NASA," says Kevin Petersen, director of Dryden Flight Research Center. "Large payloads, very long duration, high altitude and extensive range capabilities, all packaged in a highly reliable, fully autonomous unmanned aerial vehicle system."

Northrop Grumman developed the Global Hawk as a high-altitude reconnaissance platform for the U.S. Air Force and it has been used extensively in Afghanistan and Iraq.

"It provides military field commanders with high resolution, real-time imagery and other sensor data for intelligence, targeting and surveillance," says Gary Ervin, corporate vice president and president of Aerospace Systems for Northrop Grumman.

With a 116-foot wingspan, the autonomous aircraft can fly for more than 30 hours at altitudes of 65,000 feet, giving it unprecedented range for scientific observation

## GLOPAC 2009 MISSION OBJECTIVES

- First demonstration of Global Hawk unmanned aircraft system for NASA and NOAA Earth science research applications
- Validation of instruments board the Aura satellite system
- Exploration of trace gases, aerosols, and dynamics of remote upper troposphere and lower stratosphere
- Sample polar vortex fragments and atmospheric rivers
- Risk reduction for future Global Hawk missions to study hurricanes and atmospheric rivers



The Global Hawk plane features several payload bays that can house up to 2,000 pounds of modular scientific instrument packages.

in addition to military use. The Global Hawk is computer-controlled but its flight systems can be taken over by a pilot who monitors its status in real-time at an operations center at Edwards AFB.

The Global Hawk's extended flight capabilities were the main attractor for NASA, according to Petersen. "Eight years ago we started to look at new technologies and new capability platforms for future airborne science missions," he says. "The Global Hawk quickly emerged as the platform to watch."

The mission scientists for these first flights confirm Petersen's hopes for the Global Hawk. "No scientist has ever done a 30-hour flight that can go all the way from the North Pole to the equator," says project scientist Dr. Paul A. Newman of NASA's Goddard Space Flight Center in Maryland. "Imagine the environments you're looking at. Brutal cold in the polar regions, then going all the way down to the tropics and measuring the nice 80-degree surface temperatures. It's kind of mind-boggling to think of flying that far."

The range of the Global Hawk gives scientists an unprecedented high-resolution look at environmental data. The plane can carry various instruments in its payload bays and provide real-time relays of live data to the operations center at Edwards AFB.

Newman sees the Global Hawk's range as a powerful game-changer in environmental studies, especially ozone depletion. For example, while most ozone depletion occurs at the poles, greenhouse gases usually enter the atmosphere at the equator. Gathering a continuous data set on this mechanism has been difficult because while satellites can provide some observation, atmospheric conditions can change drastically from one satellite pass to the next. The Global Hawk, however, can fly from the equator to the poles and back in one mission.

"We can fly that whole string of polar latitudes where there's a lot of ozone loss going on and then fly all the way to the equator where the gases that actually cause ozone destruction get into the stratosphere," Newman says. "We get a full profile with these in situ instruments.

With this plane, we are sitting here in the control room watching the data come across."

## GloPac 2009

These and other atmospheric studies are the goals of GloPac 2009, a mission of six flights mostly over the Pacific Ocean beginning in June. The Global Hawk will carry a payload of 12 instruments measuring trace gases, aerosols, and the dynamics of the upper tropospheric and lower stratospheric regions.

But the first voyage of the Global Hawk will have a much simpler goal, according to Newman: "I think our very first flight will be to take off, go overhead, turn on all the instruments and make sure they all work, and then just land." The instrument packages will be tested to insure operational functionality in the extreme environments they will face.

"You take off at a warm humid place like Edwards Air Force Base and you immediately go to a low-pressure, very cold place. It's a hostile environment, so the first flight will just be to show that the instruments actually work," he says.

Newman and other scientists are impressed with the Global Hawk's ability to be operated remotely. They will monitor each mission from workstations at the Flight Operations Center with the mission pilot ready to take control at a moment's notice. "As we're flying along, the scientists are all sitting in the same room talking to one another and watching their data come across," says Newman. "If someone sees something come across and says, 'Hey that was interesting, what was

## GLOBAL HAWK TECH SPECS

**NAUTICAL RANGE:** 11,000 miles

**MAXIMUM ENDURANCE:** 31 hours

**ALTITUDE:** 65,000 feet

**LENGTH:** 44 feet

**HEIGHT:** 14.6 feet

**WINGSPAN:** 116 feet

**GROSS TAKEOFF WEIGHT:** 25,600 pounds

**PAYLOAD CAPABILITY:** 2,000 pounds

**ENGINE:** Single Rolls-Royce AE3007H Turbofan

**LOITER VELOCITY:** 343 knots True Air Speed

### COMPOSITION:

*Graphite composite materials:* V-tail, engine cover, aft fuselage and wing

*Aluminum:* Center fuselage

*Fiberglass composite materials:* various fairings and radomes





NASA Dryden Flight Research Center at Edwards Air Force Base will have two Global Hawks at their disposal. The first mission this June is called the Global Hawk Pacific 2009 science campaign, a mission over the Pacific Ocean.

that?’ Well, let’s turn around and go look.”

Another goal of GloPac 2009 will be validating the data received by NASA’s Aura atmospheric research satellites.

“When you launch a satellite, you never get it back,” says Newman. “So you calibrate it on the ground and you know what it’s doing, and then you launch it into space.” But the harsh conditions of outer space—subzero temperatures and solar radiation—can degrade satellite instruments over time.

NASA’s Aura system—dubbed the “A-train”—is a prime candidate for degradation of its data-gathering instruments. As one of its GloPac mission goals, the Global Hawk will fly in tandem with the A-Train over the Pacific Ocean, gathering the same data as the satellites. Later, both data sets will be compared to validate the accuracy of the satellite instrumentation.

NASA Dryden’s Petersen sees the Global Hawk program as a paradigm shift for the science community. “I believe it has the potential to enable great things,” he says, including “unprecedented earth science observations to help better understand and characterize global climate and environmental changes, and perhaps make key contributions to future generations.”

Northrop Grumman’s Ervin envisions even further possibilities as the program fine-tunes itself. “This is only the beginning for the use of Global Hawk in missions beyond the current military applications,” he says. “The system has potential applications not only for the advancement of science, but for hurricane monitoring, disaster relief, border and coastal protection, and communications relay, just to name a few.”

Andrew Roberts, the airborne science director for NASA’s Science Mission Directorate, says his agency is interested in using the Global Hawk to monitor live storm conditions.

“If we can forecast hurricanes better, we’re going to save billions of dollars,” he says, noting that erroneous forecasts of Hurricane Rita resulted in the unnecessary evacuation of citizens from the Houston, Texas area. “NOAA’s been chartered with trying to reduce the uncertainty by half and we’re trying to come up with ways to do that.”

Future plans for the Global Hawk missions also include a standardization process for scientific instruments, says Newman. By making the inclusion of new instruments more efficient, transitions between missions can be greatly simplified.

*Clark Perry is a writer living in Los Angeles.*

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